

VIII.—*Instructions relative to Botany and Vegetable Physiology, for the Scientific Expedition to the Antarctic Regions, prepared by the President and Council of the Royal Society*.*

THE duty of the Botanist should be, to collect specimens and preserve evidence concerning every department of Botany and Vegetable Physiology, not merely in illustration of these subjects as branches of science, but with reference to purposes of general utility.

The vegetation of the Antarctic regions and of the most southern countries which the expedition may visit, should be an object of especial attention, for however sterile and uninviting a place may appear to be, it is most desirable to know exactly what plants those regions produce. Here, therefore, and at all other places, as complete an herbarium as possible should be formed. At Kerguelen's land, of which the Flora is so little known, this is especially necessary: even at St. Helena, the Cape of Good Hope, and Hobart Town, carefully as the botany of these places has been examined, a dried collection of plants should be made, especially of the lower orders of phænogamous vegetation and of aquatic and submersed plants, whether of fresh or salt water. Fungi also, and Rhizanth, should be diligently sought for, and all those minute species of cryptogamic plants which are parasites.

Though but little accession to our knowledge of Systematic Botany can be anticipated at any of the principal stations of the expedition, many new and interesting facts may be collected in Physiological Botany, if anomalous forms of vegetation be examined, as concerning these so little that is positive has as yet been ascertained in foreign countries. Collections should be made of the stems of Casuarinas, Urticaceous trees, and of twining woody plants, the internal structure of which is frequently at variance with the ordinary plan of vegetable formation. Diligent search should also be made for cases of the occurrence of the embryo buds of Dutrochet. It is probable that attention skilfully directed to these last productions will throw light upon some of the most obscure points of Vegetable Physiology. Most of the specimens of this kind may be preserved in a dry state; but as some will require to be kept moist, it is re-

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Attention should be especially directed to the distribution of remarkable species in each country, regard being paid, in particular, to the elevations at which they are found, and the soils which they seem to prefer, where preference is observable. Connected with this topic are the limits to which cultivated plants extend, and the circumstances under which they succeed or fail. In noting points of this nature, facts concerning the commoner species will be interesting, because they are so frequently neglected, and because of the evidence as to climate which they may be expected to afford. In the absence of this kind of knowledge, it is difficult for persons here to judge correctly respecting the kind of plants it may be desirable to introduce into another country. Should the causes of failure or of success in the cultivation of particular plants be apparent, they ought to be noted down. As an instance of the importance of this branch of inquiry, the Vine at the Cape of Good Hope may be mentioned: the bad quality of Cape wine, with the exception of that produced at the farm of Constantia, is well known: can any physical cause be assigned for this circumstance? If exotic plants are commonly cultivated with apparent success, they should receive particular notice; European Oaks, for example, are common about Cape Town, where they are planted for their shade; the species to which they belong, and the effect of that climate upon their growth, and the quality of their timber, are points deserving of attention.

The original Flora of St. Helena should be fully investigated and carefully distinguished from that which has been gradually formed there by the introduction of numerous plants from various countries. The association of plants in this island will be found extremely curious, and the circumstances which enable species of very different habits to flourish equally well in the same place, notwithstanding their constitutional diversity, are deserving of particular attention. A very detailed catalogue should be formed of these exotics, the degree in which they are affected by their new country should be observed, and an attempt be made to discover the causes which are favourable to the maintenance of so singularly mixed a vegetation in so small an island. Such a catalogue, if well prepared, may be expected to illustrate many difficult and important questions which are connected with the relation borne by vegetation to climate.

Both at St. Helena and Hobart Town, Tree Ferns will be found: those in the former place have the stems destitute of external fibres

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except near the ground, while the Tree Ferns of Hobart Town are thickly covered with similar fibres from the very summit. The origin of these fibres and the circumstances under which they are produced, are unknown, and should, if possible, be determined; indeed, the manner of growth of these plants in all other particulars is an interesting subject for careful investigation, as are also the circumstances under which this tropical form of vegetation is produced upon Mount Wellington. In the event of the expedition visiting the southern part of New Zealand, it should also be ascertained under what conditions the Tree Ferns that exist there extend so far beyond the usual geographical limits of such trees, and also whether they are not accompanied by other forms of an equally tropical character.

The northern coast of Van Diemen's Land being in many respects clothed with a different vegetation from the south side, it is desirable to notice the peculiarities of each. At Emu Bay, there exists the *Gunnia australis*, an orchidaceous epiphyte, which is far to the southward of the general range of plants of that kind. It will probably be found that this apparent exception to general rules is dependent upon some local peculiarity of climate. Possibly other species with similar habits occur on the same line of coast; they should be sought for, and particular attention should be paid to the plants with which the orchidaceous epiphytes are associated.

A principal object of inquiry should be, plants yielding useful products of all kinds. It is in this way only that the resources of foreign countries can be ascertained, and it is presumed that in an expedition which will be stationary for considerable periods of time, such inquiries can be easily made. Under the head of useful products the following may be particularly mentioned:

1. *Dietetical, medicinal, and poisonous agents* of all kinds. The nature and action of the poisons employed by the natives of many countries are but slightly known.

2. *Dye stuffs*. Attention should be paid, especially to obtain Lichens, as substitutes for the *Rocella tinctoria*, now becoming scarce, and consequently very valuable in European commerce. The fitness of these plants for this purpose may be approximately ascertained by Hellot's lichen test, which is as follows: digest the lichen at a temperature of 130° F. for a few hours, in a weak solution of ammonia, but sufficiently strong to be tolerably pungent. One that is fit for the dyer will yield a rich violet red liquid.

3. *Astringent substances adapted for tanning*. It is desirable to ascertain with accuracy the source of the various astringent extracts

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4. *Fibres adapted for cordage and weaving.* Substitutes for Hemp are very desirable. Great strength, flexibility and freedom from injurious influence in working are three essential qualities of good hemp.

5. Information respecting the source of many of the *ornamental woods* imported from the southern hemisphere is very imperfect. It is desirable, therefore, that inquiries be made on this subject as well as for new kinds of wood.

6. *Gums, resins, volatile oils, fecula.* Especially the source of some resins brought to this country from New Holland, and which are analogous in some properties to the *yellow resin* of that country.

In forming collections of such objects, especial care must be taken when collected to number alike both the products and the plants by which they are furnished, and to note whatever can be learned concerning them, more particularly with regard to their abundance and the facility with which they can be procured. It is also necessary that the observations made by the Botanist himself should be carefully distinguished from such information as he may receive from other persons.

No opportunity is to be lost of collecting information respecting the source and mode of preparation of any vegetable substances known in commerce; for many exotic products, even those with which we are most familiar, have many points connected with their natural history deserving attention.

The vegetation of South Shetland cannot be expected to furnish much that can be made available for purposes of commerce, except Lichens. With respect to these plants, however, it is possible that species fit for the purposes of the dyer may be found in those southern latitudes; and if such should prove to be the case, an additional source of profit may become available for the South-sea traders.

Where the native names of useful plants can be correctly ascertained, they should be preserved; but care must be taken to avoid error in this respect. Implicit credit must not be given to the statements of individual natives; it is only by comparing the separate evidence of different persons, that correctness can be expected.

Collections should be formed of the seeds and bulbs of useful and ornamental plants wherever opportunities occur, and they should be forwarded to Europe from time to time. It is also recommended that duplicate collections be transmitted to the Supreme Govern-

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5. Information respecting the source of many of the *ornamental woods* imported from the southern hemisphere is very imperfect. It is desirable, therefore, that inquiries be made on this subject as well as for new kinds of wood.

6. *Gums, resins, volatile oils, fecula.* Especially the source of some resins brought to this country from New Holland, and which are analogous in some properties to the *yellow resin* of that country.

In forming collections of such objects, especial care must be taken when collected to number alike both the products and the plants by which they are furnished, and to note whatever can be learned concerning them, more particularly with regard to their abundance and the facility with which they can be procured. It is also necessary that the observations made by the Botanist himself should be carefully distinguished from such information as he may receive from other persons.

No opportunity is to be lost of collecting information respecting the source and mode of preparation of any vegetable substances known in commerce; for many exotic products, even those with which we are most familiar, have many points connected with their natural history deserving attention.

The vegetation of South Shetland cannot be expected to furnish much that can be made available for purposes of commerce, except Lichens. With respect to these plants, however, it is possible that species fit for the purposes of the dyer may be found in those southern latitudes; and if such should prove to be the case, an additional source of profit may become available for the South-sea traders.

Where the native names of useful plants can be correctly ascertained, they should be preserved; but care must be taken to avoid error in this respect. Implicit credit must not be given to the statements of individual natives; it is only by comparing the separate evidence of different persons, that correctness can be expected.

Collections should be formed of the seeds and bulbs of useful and ornamental plants wherever opportunities occur, and they should be forwarded to Europe from time to time. It is also recommended that duplicate collections be transmitted to the Supreme Govern-

ment at Calcutta for distribution among the botanical gardens of India. In packing these collections, the best method is to enclose each kind of seed in separate packets of brown paper, which should be placed loosely in canvas bags, or in boxes with holes in their sides, and arrangements should be made for their being transmitted in a cabin, or some well-ventilated part of the ship. Among those seeds which it is more particularly desirable to procure, may be mentioned the arborescent *Compositæ* of St. Helena, and the native Coniferous plants of all countries, particularly the *Phyllocladus* or Celery-leaved Pine, and the various species of *Athrotaxis* inhabiting the mountains of Van Diemen's Land. As the seeds of such plants are apt to suffer from long keeping, and as other instances may occur when it would be desirable to send home young plants instead of seeds, it would be advisable that the expedition should be supplied with one of Mr. Ward's glazed cases, to be used if occasion should arise.

Light is an agent which operates so powerfully upon plants, determining the amount and even nature of their secretions, and influencing in the most essential manner their vital actions, that it would be most interesting to obtain, if possible, some good photometrical observations. The extreme and mean temperatures of the atmosphere, its humidity, the quantity of rain, and the temperature of the earth immediately below and within a few feet of the surface, have also a direct and important bearing upon Vegetable Physiology, especially when considered with respect to the distribution of plants, and the arts of cultivation. Observations upon all such points tend to explain the connexion which exists between vegetation and climate, and should be introduced by the Botanist into his report, notwithstanding that they also occur in the Meteorological Journal.

If the observations here recommended be briefly noted in a tabular form, and at the time that they are made, the registration of much useful matter which might otherwise escape recollection, will be secured, and a valuable document formed for future reference.

In conclusion, the Council most particularly recommend that the Botanist to the expedition be directed to number all the objects collected by him in one consecutive series; that the dried specimens, seeds, woods, and productions of all kinds, shall correspond in number with the plants producing them; and that two complete collections be prepared for Government, of which one shall be for incorporation with the general collections belonging to the public, and the other be preserved separately, to illustrate the botany, &c.,

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Zoology and Animal Physiology.

1. MARINE INVERTEBRATA.

THE animals which it is desirable to preserve, and which may first present themselves to the notice of the naturalist in the present expedition, are the floating marine *Mollusca* and *Crustacea*, and those which inhabit the Sargazzo or Gulph-weed.

With respect to the *Mollusca*, all the species of the *Cephalopoda* or Cuttle-fish tribe, and all the *Pteropoda* or lower organized floating *Mollusca*, should be preserved. If taken alive they should be allowed to die gradually in sea water, by which means they commonly remain in a relaxed state, and display more of their natural outward form. When dead they should be soaked for a short time in fresh water, and then put into spirit; or if transparent, in the saline solution*, to prevent decomposition, which otherwise rapidly takes place.

To each specimen should be attached a number, stamped on sheet tin, corresponding to the entry-number in the Catalogue, in which should be noticed the kind of locomotion, or other vital phenomena, and the colour of the living animal, the latter being speedily altered or lost in the preserving liquor. The larger *Crustacea* will be liable to become putrid in spirit, unless the soft mass, which fills a large portion of the body, consisting of the liver, &c. be removed. Each specimen of this class, excepting the very minute ones, which will be best preserved in small phials or glass tubes, should be wrapt in a piece of very soft, thin linen or cotton cloth, to prevent the legs from being intermixed or lost, as they are very likely to fall off after having been a short time in spirit.

A very important object of investigation is the development of the *Crustacea*, from the earliest period at which they can be observed to the perfect state. They may be readily examined even before they leave the egg, by opening the egg under a single microscope.

* Common salt.....	1 part.
Alum.....	2 parts.
Boiling water	10 parts.

Filter the solution when cold.

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Drawings of these changes are very desirable, and when practicable the eggs and young ones in different stages should be preserved in spirit in short glass tubes. The smaller oceanic Crustacea offer a prolific and hitherto unexplored field of investigation.

Among the floating Mollusca likely to be met with in the tropical latitudes is the *Spirula*, a small Cephalopod with a chambered shell. An entire specimen of this rare Mollusk is a great desideratum; and if it should be captured alive, its movements should be watched in a vessel of sea water, with reference more especially to the power of rising and sinking at will, and the position of the shell during those actions.

The chambered part of the shell should be opened under water, in order to determine if it contain a gas; the nature of this gas should likewise, if possible, be ascertained. As a part of the shell of the *Spirula* projects externally at the posterior part of the animal, this part should be laid open in the living *Spirula*, in order to ascertain how far such mutilation would affect its power of rising or sinking in the water. In the event of a living Pearly Nautilus (*Nautilus Pompilius*) being captured, the same observations and experiments should be made on that species, in which they would be attended with more precision and facility, as the species is much larger than the *Spirula*, and its shell external. The towing-net should be kept overboard at all practicable periods, and drawn up and examined at stated intervals, as some of the rarest marine animals have been taken by thus sweeping the surface of the sea.

A sketch or drawing of Molluscous and Radiate animals, of which the form and colour are liable to be materially altered by death, or when put in spirit, will aid materially in rendering the description of the species useful and intelligible. The *Echinodermata* and *Asterias echinus*, and similar forms, should be soaked in fresh water previously to their being put into spirit.

Care must be taken not to crowd too many soft-bodied Invertebrata in the same bottle, and to change the spirit or preserving liquor at least once, if not oftener.

2. FISHES.

The mode and speed of swimming, living colour, temperature, and any other peculiarity, should be noticed before placing the specimen in spirit.

In very large specimens of the Shark or Ray kind, a section of the jaws, with a part of the vertebral column, should always be preserved as wet preparations, and the remainder of the jaws and ver-

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tebral column in a dry state. The eyes, cyclics, and part of the surrounding skin should be preserved in the saline solution. In less bulky specimens the entire head should be taken off by dividing the fish below the heart across the upper part of the liver, by which means the mouths of the oviducts, if it be a female, the heart, gills, and head are all preserved together.

The tail of a Shark may be taken off a little below the anus, and the trunk alone preserved for examination. If the trunk be too large, it should be cut through above the pelvis, and the parts contained in the hinder portion, as the claspers of the male, should be preserved in spirit. If the specimen be a female, separate the two oviducts through their whole length, where they run along the abdomen, on each side of the spine, but keep them attached to the cloaca and its surrounding parts.

If with young, or eggs, take the whole out in the same way without opening the oviducts.

The heads of all fishes should be preserved, when the specimens are too large to be preserved entire.

All external parasites, and those which infest the gills of fishes, should be preserved. The alimentary canal should, in all cases, be examined for the presence of the entozoa, which, if adherent to the coats of the intestine, should be preserved with the part to which they are attached. One of the most interesting fishes of the Southern Seas is the Port Jackson Shark (*Cestracion Philippi*). Moderate sized specimens of this species should be preserved entire: and the head, vertebræ, with the dorsal spines, viscera, and especially the impregnated oviduct, should be preserved. The Southern Chimæra (*Callorhynchus antarcticus*) merits also the especial attention of the Naturalist, and the same specimens of this species should be preserved as of the *Cestracion*.

3. REPTILES.

Specimens of Turtle should be carefully examined for parasitic animals; a curious Barnacle (*Chelonobia*) and a Leech (*Hirudo branchiata*) are occasionally found adhering to these marine Reptilia.

In the event of the expedition touching at the Galapagos Islands, specimens of *Amblyrhynchus*, a lizard of marine habits, should be secured, and the particular locality of the capture noted.

4. BIRDS.

The *Chionis* or Sheath-bill of the Falkland Islands and Cape Horn. The Great Penguin (*Aptenodytes*).

The Penguin of the Isle San Lorenzo.

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In the event of the expedition touching at the Galapagos Islands, specimens of *Amblyrhynchus*, a lizard of marine habits, should be secured, and the particular locality of the capture noted.

4. BIRDS.

The *Chionis* or Sheath-bill of the Falkland Islands and Cape Horn. The Great Penguin (*Aptenodytes*).

The Penguin of the Isle San Lorenzo.

tebral column in a dry state. The eyes, cyclics, and part of the surrounding skin should be preserved in the saline solution. In less bulky specimens the entire head should be taken off by dividing the fish below the heart across the upper part of the liver, by which means the mouths of the oviducts, if it be a female, the heart, gills, and head are all preserved together.

The tail of a Shark may be taken off a little below the anus, and the trunk alone preserved for examination. If the trunk be too large, it should be cut through above the pelvis, and the parts contained in the hinder portion, as the claspers of the male, should be preserved in spirit. If the specimen be a female, separate the two oviducts through their whole length, where they run along the abdomen, on each side of the spine, but keep them attached to the cloaca and its surrounding parts.

If with young, or eggs, take the whole out in the same way without opening the oviducts.

The heads of all fishes should be preserved, when the specimens are too large to be preserved entire.

All external parasites, and those which infest the gills of fishes, should be preserved. The alimentary canal should, in all cases, be examined for the presence of the entozoa, which, if adherent to the coats of the intestine, should be preserved with the part to which they are attached. One of the most interesting fishes of the Southern Seas is the Port Jackson Shark (*Cestracion Philippi*). Moderate sized specimens of this species should be preserved entire: and the head, vertebræ, with the dorsal spines, viscera, and especially the impregnated oviduct, should be preserved. The Southern Chimæra (*Callorhynchus antarcticus*) merits also the especial attention of the Naturalist, and the same specimens of this species should be preserved as of the *Cestracion*.

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5. MAMMALIA.

The skulls, skeletons, and viscera of a specimen of each species of the *Cetacea* of the Southern Ocean are worthy of being preserved. With respect to the Sperm Whale, an entire fœtus, or, if of large size, the brain, eyes, pharynx, larynx, and blow-holes, and the viscera; a part of the impregnated uterus; the ovaria, and a portion of the membrane of the fœtus; are all parts worthy of preservation.

The same observations apply to the great Elephant-Seals (*Phoca (Cystophora) proboscidea*); of which the skull and skeleton of both male and female are very desirable.

The skulls or skeletons of all the species of the Southern Seals should be preserved, the sex being noted.

6. IN PARTICULAR REGIONS.

In Australia or Van Diemen's Land the following species are more especially worthy of attention.

Thylacinus Harrisii, Hyæna of the Colonists.

Of this species, the skeletons of male and female, detached skulls, an entire specimen in the saline solution for dissection, the viscera, and more especially the impregnated uterus, and a young specimen for the changes in dentition are particularly desirable; such specimens not having been as yet transmitted to the museums of this country or on the continent.

The skeletons, skulls, and female organs of every marsupial quadruped, and of the *Ornithorhynchus* and *Echidna* (or Porcupine of the Colonists) should be preserved.

The smaller Mammalia of Australia, whether Marsupial or Rodent, should be preserved in spirit, and particular notice taken of their locality and habits.

Among the birds of Australia the Lyre-Pheasant (*Menura*) would be an interesting subject for anatomical investigation. Of this species are wanting the skeletons of a male and female, and of the young bird; and the entire body of both sexes in spirit, or the saline solution.

The same with respect to the large-billed Cuckoo (*Scythrops*), and Sea-Partridge (*Glareola*).

In New Zealand similar preparations should be obtained of the *Megapodius*, and of the *Apteryx australis*.

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